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Meadow foxtail

a production guide

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Meadow foxtail
a production guide

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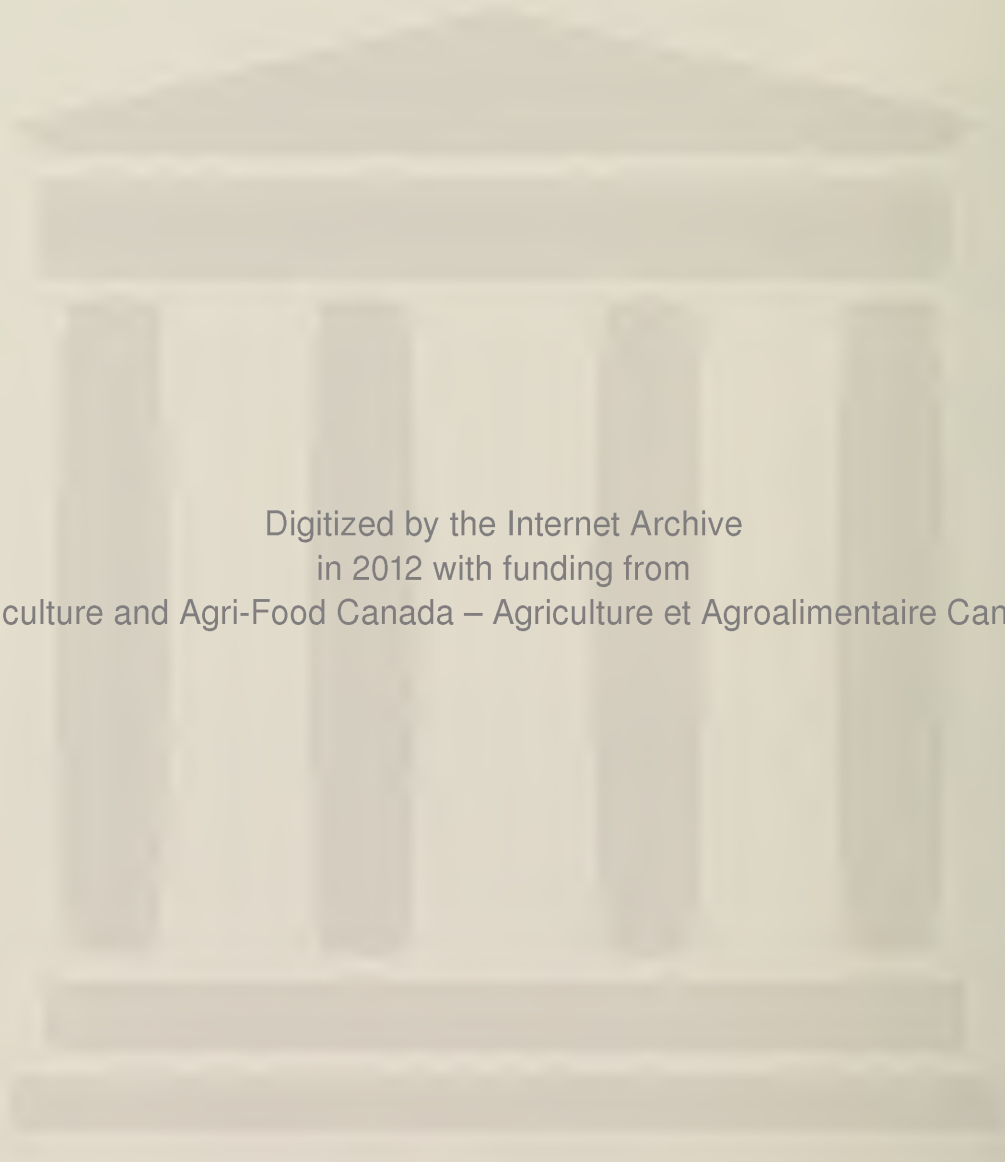

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Questions about meadow foxtail answered

Where can I grow meadow foxtail?

You can grow meadow foxtail in areas where flooding occurs because of either poor internal drainage or high water tables, on heavy-textured (clay) or Organic (peat) soils. It is best suited to the cool, temperate climates (see "Introduction, Adaptation").

Should I use coated seed?

Meadow foxtail seed is light and fluffy, which makes it difficult to sow with conventional seeding equipment. Coating the seed enables it to be distributed more evenly using conventional seeding equipment and generally also improves its establishment (see "Management, Establishment").

How does meadow foxtail's yield and quality compare to other grasses?

In an evaluation of seven grass species at seven locations throughout central British Columbia, meadow foxtail yielded 68% dry matter of reed canarygrass and 72% of timothy. However, the in vivo digestible dry matter, crude protein concentration, and the mineral content of phosphorus, potassium, copper, and zinc were all significantly greater than other grasses evaluated (see "Management, Fertilization and dry matter yields" and "Usage").

Can I use meadow foxtail for hay, silage, and pasture?

Although meadow foxtail is best suited for pasture, you can use it for both hay and silage production. Its early growth produces grazable pasture before other grasses. If used for hay and silage, it needs to be cut early and more often than most other grasses because it matures much earlier (see "Usage, Pasture, hay, and silage production").

How palatable is meadow foxtail for cattle?

On the basis of chemical quality it appears to be an excellent forage with a high nutrient content. However, feeding trials have indicated that cattle and sheep often prefer other grass species when given the choice. This preference is thought to be mainly because meadow foxtail matures much earlier than other grasses and is overmature when harvested (see "Usage, Pasture, hay, and silage production").

Introduction

Meadow foxtail (*Alopecurus pratensis* L.) is a perennial grass (Fig. 1) that is well suited to early spring grazing in lowlands where soil moisture is high. The name "foxtail," however, conjures up thoughts of either the dreaded foxtail barley (*Hordeum jubatum* L.), whose long awns (Fig. 2) can injure livestock, or green foxtail (*Setaria viridis* [L.] Beauv.) (Fig. 2) and yellow foxtail (*Setaria glauca* [L.] Beauv.) both of which can be serious weeds in annual crops. Although the head shape of these other grasses resemble a fox's brush more than that of meadow foxtail, the name *Alopecurus* is derived from the Greek, *Alopex* meaning "fox" and *oura* meaning "tail." The head of meadow foxtail is so easily confused with timothy (*Phleum pratense* L.) (Fig. 2) that it has also been called Scotch timothy and French timothy. On close examination though, meadow foxtail is more velvety to the touch than the bristly head of timothy. Meadow foxtail is not related to any of these grasses.

Meadow foxtail (Fig. 2) is similar in growth and adaptation to Garrisons creeping foxtail (*Alopecurus arundinacea* Poir.). Although many of the management procedures and uses apply to both grasses, the data presented here are from trials with meadow foxtail only. Under intensive management meadow foxtail can be a very serviceable grass with special value for wet areas and early spring grazing.

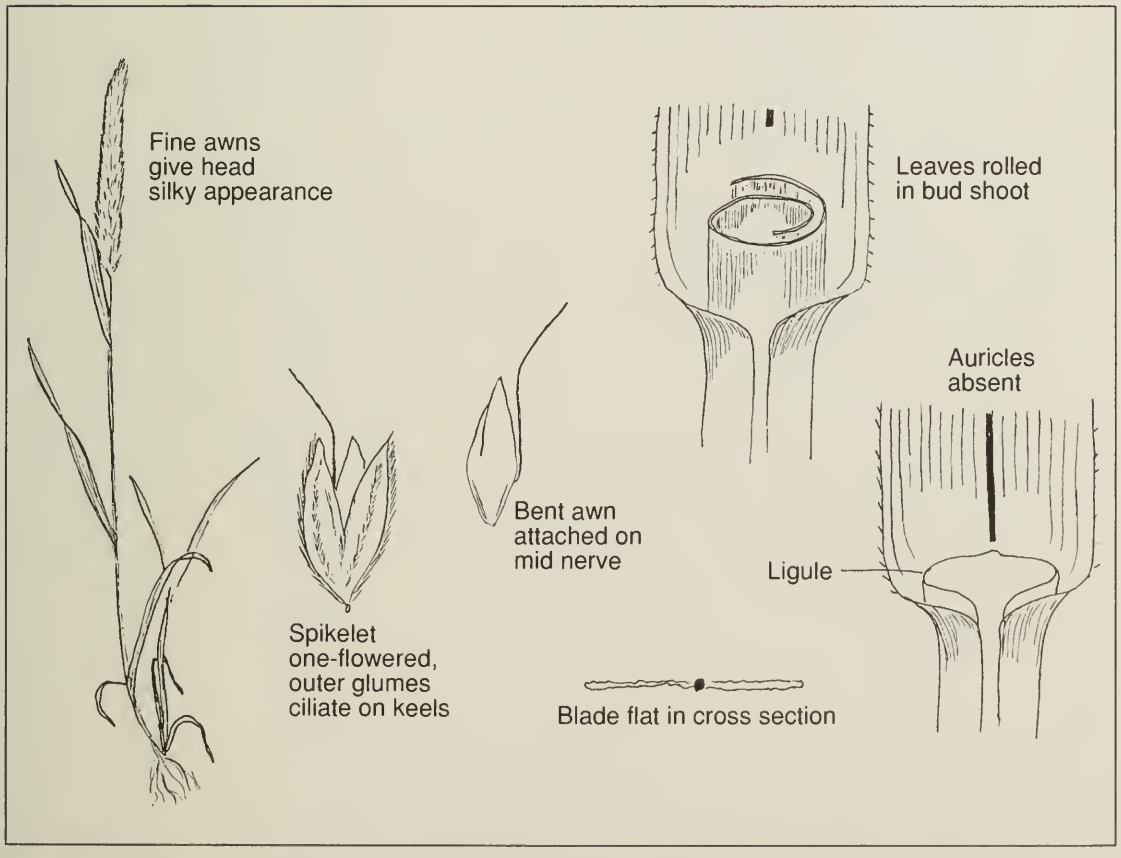

Fig. 1 Characteristics of meadow foxtail (drawn by P. Kline adapted from Herbert B. Hartwig, 1950. *Picture aids to grass classification.* Ithaca, N.Y.).

Fig. 2 Meadow foxtail (*top left*), **timothy** (*top right*), **foxtail barley** (*bottom left*), **and yellow foxtail** (*bottom right*). **(After Looman, J. 1982. *Prairie grasses identified by vegetative characters*. Agric. Can. Publ. 1413.)**

Description

Meadow foxtail is noted for its dark green color, which stands out when this grass is grown with other pasture forages. It grows about 30 – 80 cm tall. A large proportion of the plant consists of basal leaves. The numerous leaf blades are rolled in the bud shoot when they emerge and at maturity they can be as much as 1.0 cm wide.

The flowering heads are erect. Their silky appearance is caused by the fine hairs on the glumes and by the long bent awns on the seeds. The seeds are light, fluffy, and pale colored.

The underground branches and rootstocks are short and not aggressive. Although meadow foxtail forms loose tufts, medium-dense sods are produced by old stands (Fig. 2).

Adaptation

Meadow foxtail has been cultivated for about 250 years but was introduced to North America only in the late 1800s by an immigrant from eastern Europe. Now it can be found growing freely in many low, wet areas where it is best adapted.

In North America meadow foxtail is particularly suited to the cool, temperate climates of Canada and northern United States (see Box 1). It thrives best in moist areas and therefore grows naturally in swampy

Box 1 Meadow foxtail finds its place across Canada ...

- in British Columbia

  Meadow foxtail is well adapted to the cool, poorly drained, acidic soils of the central interior of British Columbia. For more than 25 years, growth and utilization studies have been conducted at the Prince George Experimental Farm on heavy clay soils. When fertilized with nitrogen (in the spring and after each cut, up to three cuts) meadow foxtail can yield up to 6885 kg/ha of dry matter annually.

- in Northern Alberta

  The Pembina Forage association reported satisfactory animal gains when meadow foxtail was grazed by steers in rotational grazing studies on wetland meadows. Annual dry matter yields of more than 13 000 kg/ha accumulated over three cuts have been obtained at Beaverlodge, Alberta in experimental plots.

- in Ontario

  Tests by the Ontario Forage Council showed that meadow foxtail, if managed correctly, can outyield timothy. Annual yields of more than 10 000 kg/ha have been obtained in the Ottawa valley. Trials at New Liskeard and Kapuskasing have yielded about 6000 kg/ha dry matter annually.

areas and near ponds and streams. This grass has the ability to withstand floods and is well suited to peaty meadows where soil moisture is high and organic matter is abundant.

Because of its frost tolerance and its ability to grow in cool conditions, meadow foxtail is one of the first grasses to become green in the spring (Plate 1*a*). It is often already actively growing when the snow recedes and recovers vigorously after ice-capping or freeze-thaw conditions. This characteristic of meadow foxtail gives the producer and rancher the added benefit of early spring grazing (Plate 1*b*).

Meadow foxtail is not drought tolerant and therefore is not suitable for areas that experience long periods of drought. Low soil moisture results in meadow foxtail becoming semidormant until moisture conditions improve. It grows best where adequate moisture is present consistently. Meadow foxtail responds to irrigation though it has not been used extensively under irrigation.

In wet years, spring growth and annual yield can be high and flooding does not impede its development. Meadow foxtail can withstand depths of cool water, 60 – 90 cm, for up to 30 days without injury. This grass thrives on a certain amount of flooding as indicated by subsequent increased rates of growth, which give it a competitive advantage. Native sedges and rushes will diminish as meadow foxtail becomes the dominant species in wet areas.

Meadow foxtail tolerates both acid and alkaline soil conditions. It grows well within a pH range of 5.1 – 8.4. Tolerance to alkaline soils depends directly on the availability of soil moisture. Soil salinity has an adverse effect on the growth and development of meadow foxtail.

Cultivars

Most meadow foxtail seed used in Canada is common Canada No. 1 and only two cultivars, Dan and Mountain, are now licensed in this country. Both cultivars have similar maturity rates, yields, winterhardiness, and chemical quality.

Dan Licensed in 1987, this cultivar originated in Poland.

Mountain Licensed in 1989, this cultivar was developed by O. Pick and Sons Seeds. It is selected for early spring growth, and fall growth, seed yield, and freedom from leaf disease.

Management

Establishment

Ideal locations to seed this grass include peaty and muskeg soils, sloughs, flood plains with a high water table, and other wet areas. Spring sowing is best in most locations. However, because this grass is best suited for wet areas it may be impossible to get equipment on the land early in the spring. In this case delay sowing until the soil is firm but still moist and there are at least 6 – 8 weeks of growing season

Plate 1.

a **Meadow foxtail in (*foreground)* is the first grass to green-up in the spring.**

b **Meadow foxtail is ready to graze earlier than other grasses.**

available before hard frosts. Fall or early winter sowing has been successful if it is late enough to restrict germination until spring.

Seed at a depth of 0.5 – 1 cm at 15-cm spacing between rows into a firm, moist seed bed. It is important to seed shallow, and to compact after seeding especially on peat and muskeg soils. This spacing prevents weed infestation, which is a common problem during establishment. Seed can also be broadcast and harrowed in lightly.

Seed at rates of 9 – 13 kg/ha for bare seed but increase seeding rate accordingly to adjust for weight of coated seed (see Box 2). Always check the germination percentages of the seed before planting because its germination declines rapidly with age of seed. Adjust seeding rates accordingly. Seedlings will emerge within 2 weeks of seeding when soil moisture and temperature are sufficient.

Box 2 Coated seed is helpful for establishment ...

- Meadow foxtail because of its light, fluffy seed can be difficult to distribute evenly with conventional seeding equipment. Purchase of seed coated with calcium and magnesium carbonates or phosphates aids in even distribution of the seed. Seeding rates must be adjusted as the coated seed contains only about 25% seed by weight.

- Trials at Prince George's Experimental Farm showed that coating the meadow foxtail seed lowered the germination rate slightly. Bare seed gave 65% germination whereas the coated seed had only 55% germination. Although there was a drop in germination when tested under laboratory conditions there was no significant difference in dry matter yield and protein content of field plots that were seeded with either coated or bare seed.

Weed control

When meadow foxtail is grown for seed, weed control is important. Be sure that the seed and the site are as weed free as possible. Proper tillage or a herbicide such as glyphosate can be used before seeding to control weeds such as Canada thistle, toadflax, and quack grass. Chemical weed control methods are limited once the stand is established. Basagran and Lontrel are the only herbicides registered for use in meadow foxtail seed stands. Other herbicides can cause injury to meadow foxtail heads and may result in reduced seed yield.

For forage production many more herbicides are available to control broadleaf weeds, but recommendations vary with locality. Consult with your provincial agricultural extension personnel for recommendations in your specific locality.

Mixtures with legumes and other forages

Meadow foxtail has such early growth that, when grown in a mixed stand, the other forages have little growth that can be grazed when the meadow foxtail is ready. Waiting for the other forages to grow before using the pasture results in the meadow foxtail becoming overmature. Livestock will then selectively overuse the more palatable immature species and underuse the overmature meadow foxtail.

Wet areas particularly suited for meadow foxtail are not generally sites that promote good legume production. Birdsfoot trefoil and alsike clover have been used to some extent as they can tolerate wetter environments than other legumes. However, they grow considerably later than meadow foxtail. Birdsfoot trefoil competes poorly with meadow foxtail and therefore can be difficult to establish in mixtures. In mixed stands of meadow foxtail and birdsfoot trefoil at Prince George, seeding patterns that used alternate rows of each species or cross seedings reduced competition among the two species.

Meadow foxtail is a poor choice as a companion hay crop, because problems with lodging occur and differences in maturity make this mixture difficult to manage.

Fertilization and dry matter yields

The yield of meadow foxtail, as with other grasses, depends on the amount of available nutrients within the soil. Grasses are grown on a wide range of soil types and environmental conditions; thus fertilizer needs vary.

Of all nutrients that are applied to the soil, nitrogen is generally the most needed, is the most concentrated in the crop, and has the greatest effect on crop growth. The general response of grass crops to nitrogen has been well established (Fig. 3). At low rates of application the yield of dry matter increases linearly whereas crude protein remains relatively unaffected. At high rates of nitrogen application additional nitrogen increases the yield of crude protein more than that of dry matter (see Box 3). In a fertilizer test at Prince George, B.C. (Table 1), nitrogen applied at 90 and 180 kg/ha to an established stand increased yields of dry matter by 300 and 400%, respectively, when compared to no applied nitrogen. Yields of crude protein increased by 300 and 500% from the addition of nitrogen at 90 and 180 kg/ha, respectively. Yields can be further increased by adding nitrogen after each cut. Adding nitrogen at 90 and 180 kg/ha after each cut at Prince George resulted in yields of 6800 kg/ha and greater.

Nitrogen applied at moderate rates (45 – 90 kg/ha) in the spring benefits the first cut in particular, because most fertilizer is absorbed readily by the growing crop. High nitrogen rates (180 kg/ha) or split applications supply nitrogen to the second or later cut. Because meadow foxtail is an early growing grass and can usually have more cuts per season than reed canarygrass or timothy, split applications of fertilizer to meadow foxtail appear to be more beneficial. However, later in the season, as the days get shorter and the soil drier, growth response to fertilizer declines noticeably.

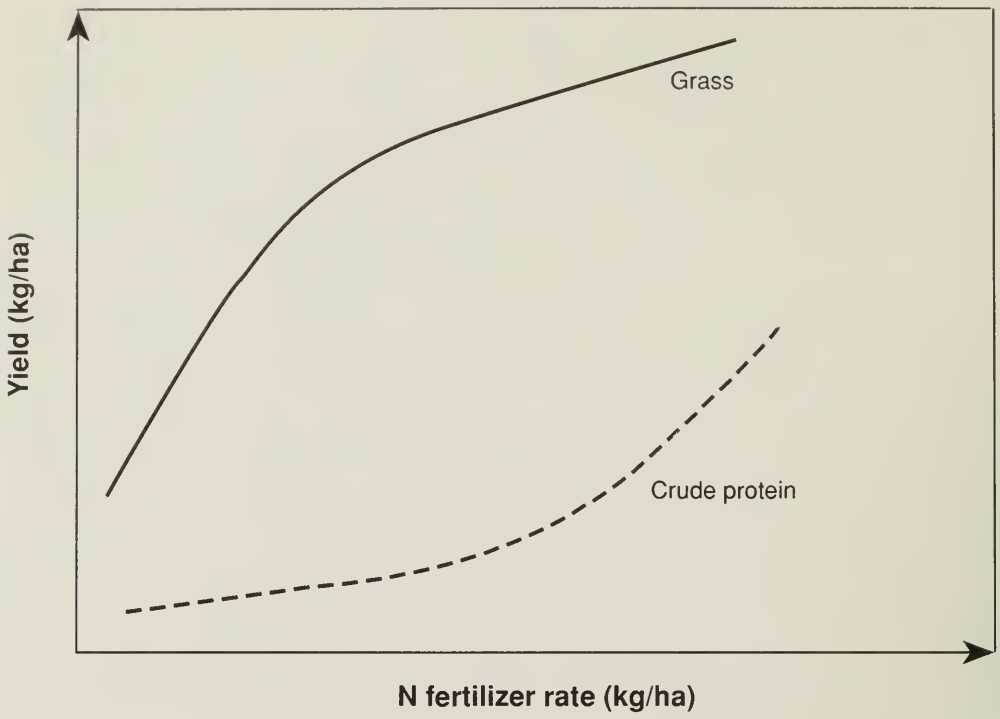

Fig. 3 Generalized crop response to applied fertilizer nitrogen.

Box 3 Some nitrogen is good, more is not necessarily better!

- Under high nitrogen fertilization regimes, meadow foxtail accumulates nitrates. In a 4-year study at Prince George, B.C., nitrate levels increased with increasing levels of nitrogen fertilization. Meadow foxtail accumulated more nitrate (NO_3-N) than either reed canarygrass or timothy at the same level of nitrogen fertilization. Meadow foxtail has the potential to accumulate toxic quantities of nitrates when fertilized with high or repeated applications of nitrogen. The minimum safe level of nitrate for cattle (0.15%) was often exceeded when the grass was fertilized with nitrogen at rates greater than 100 kg/ha.

- High fertilization rates can also cause other problems. Lodging, which can be attributed to high nitrogen, prevents a good seed harvest.

Table 1 Dry matter yields of meadow foxtail at Prince George with nitrogen applied either in spring only or after each cut

In spring only		In spring and after each cut	
N applied	Yield	N applied	Yield
(kg/ha)			
0	1346	0	1346
45	3059	45	5654
90	3990	90	6779
180	5549	180	7109
360	6794		

A well-established and vigorous stand of meadow foxtail yielding about 5000 kg/ha annually will take up about 125 kg of nitrogen, 40 kg of phosphorus (P_2O_5), 150 kg of potassium (K_2O), and 15 kg of magnesium (MgO). A crop that is managed as hay needs fertilizing more than pasture because more nutrients are removed from the field. To compensate for the loss of nutrients, replace elements according to soil test recommendations and inspect the crop regularly for signs of nutrient deficiencies.

The amount of fertilizer added to a crop is an important annual input cost; base the decision about how much fertilizer to use on the following:

- local soil test recommendations
- cost of the fertilizer
- expected increase in yield
- increased quality
- value of feed
- value of seed.

To safeguard the quality of the feed it is important to graze, and, harvest, and store the feed properly to protect your investment.

Usage

Quality

Meadow foxtail has high chemical quality as shown by laboratory analysis. Protein and mineral levels have always been consistently higher than other grass species under the same conditions. Comparison of seven grass species including meadow foxtail in a large trial from

seven locations in central British Columbia showed that meadow foxtail averaged the lowest yield yet its apparent chemical quality was one of the best (Table 2). Crude protein, digestible dry matter, phosphorus, and trace minerals were all consistently higher than the other grasses.

Meadow foxtail shows consistently higher concentrations of phosphorus than other grasses grown under the same soil and conditions. When feeding meadow foxtail to livestock, it is important to check calcium-to-phosphorus ratios. Calcium concentrations in this grass do not increase as do the phosphorus concentrations, especially in the early growth stages. Calcium supplementation may be necessary when feeding meadow foxtail.

Table 2 Average yield and chemical composition of meadow foxtail and timothy at seven locations in north central B.C. with three consecutive annual seeding each harvested for 3 years for a total of nine harvest years at each location

	Grass species	
Parameter	Meadow foxtail	Timothy
DM yield (kg/ha)	4480	6227
Digestible DM* (%)	70.6	61.4
DDM** yield (kg/ha)	3180	3785
Crude protein (%)	17.1	10.9
Crude protein yield (kg/ha)	758	658
Phosphorus (%)	0.34	0.22
Calcium (%)	0.25	0.27
Ca-to-P ratio	0.74	1.21
Potassium (%)	3.0	2.1
Magnesium (%)	0.17	0.15
Manganese (ppm)	79.2	46.6
Copper (ppm)	5.9	3.5
Zinc (ppm)	35.2	27.9

* DM is dry matter.

** DDM is digestible dry matter.

Pasture, hay, and silage production

Meadow foxtail is best suited as a pasture grass. It has small, densely spaced tillers which make it well adapted to grazing. Early in the season the growth may exceed the rate at which the grass is grazed, therefore, cutting the extra growth may be necessary to keep it in a vegetative state for grazing. If stocking rates are not sufficient to keep up with the tremendous early growth of meadow foxtail, the plant flowers and the leaves senesce, giving a build up of leaf litter that is not beneficial to animal production.

Meadow foxtail's rapid early growth results in good animal gains and greater stocking rates as compared to timothy during early spring grazing. These gains on meadow foxtail are not maintained and stocking rates fall rapidly at the time when timothy production is increasing. After mid June animals gain more on timothy than on meadow foxtail. Because growth of meadow foxtail is so early, heading also occurs early; therefore, grazing should take place before the grass matures and becomes less palatable (Fig. 3).

During the summer grazing season, drought conditions may impede the growth of meadow foxtail on the heavy clay soils such as those found in the central interior of British Columbia and on the drier upland areas. Other grasses with more drought tolerance are recommended for pasture where summer drought is common. Regrowth of meadow foxtail in early fall endures heavy grazing after other pastures have been depleted.

Although meadow foxtail can be cut for hay, other grass species usually have better yields with a single cut. In a single year, three to four cuts could be possible but the extra cost of harvesting lower yields of each cut may make it impractical. Meadow foxtail is usually ready for harvest in late May or early June when weather conditions are often unpredictable. Date of cutting trials have shown that there is a marked decrease in quality after heading has occurred (Figs. 4 and 5).

Meadow foxtail can be harvested for silage. Demonstrations using meadow foxtail silage have shown that it ensiled well and cattle consumed it readily. Further investigations need to be taken for a better assessment of quality and productivity of meadow foxtail silage.

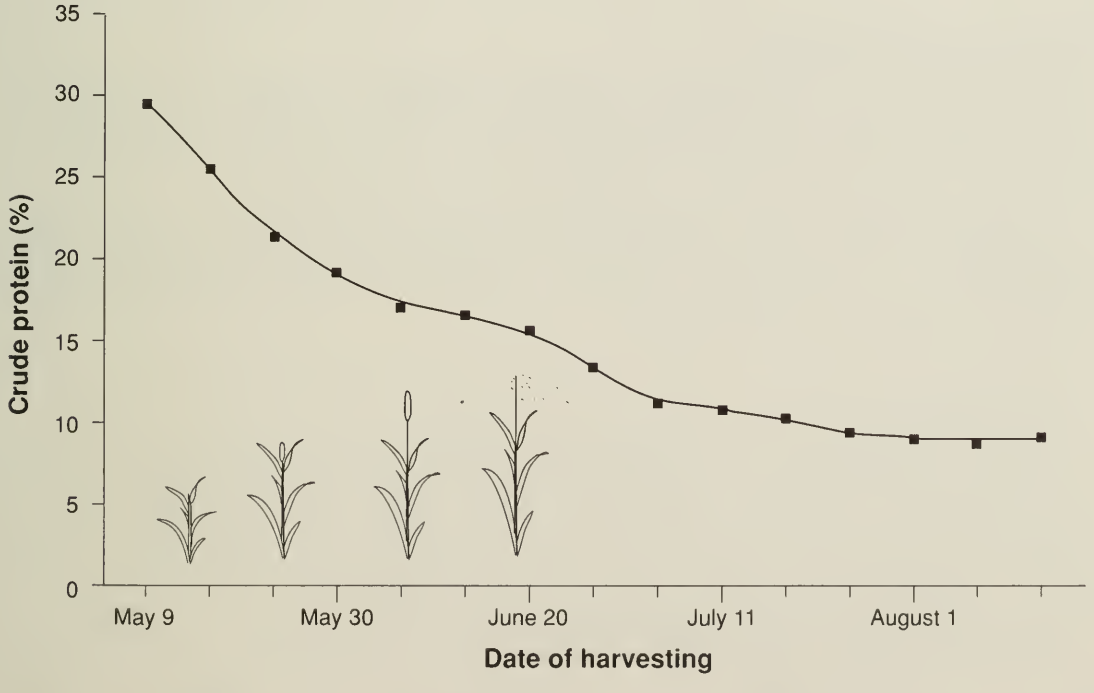

Fig. 4 Meadow foxtail crude protein (CP) content at date of harvesting, when fertilized at recommended rates.

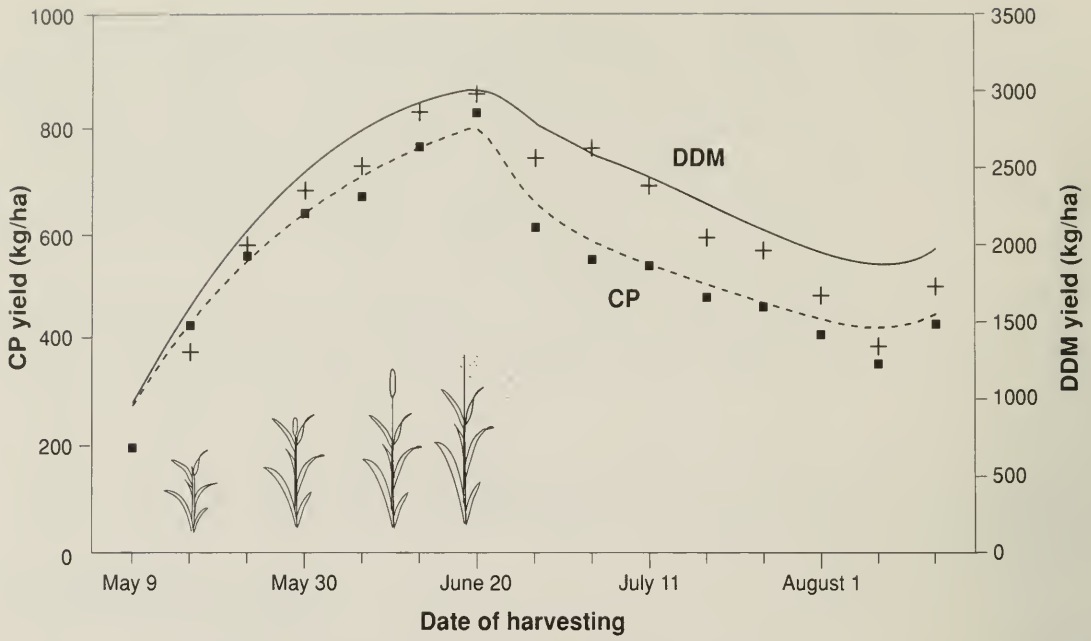

Fig. 5 Meadow foxtail yield of crude protein (CP) and digestible dry matter (DDM) at date of harvesting, when fertilized at recommended rates (crude protein yield = % CP × DM yield).

Leaving the harvest of a hay crop until better weather conditions prevail allows a seed harvest from meadow foxtail. The straw can be fed as forage. This practice overcomes the problem of unpalatable seed heads (see Box 4).

Seed production

Seed production presently is limited mainly to Oregon, although a small amount occurs in Alberta. Meadow foxtail is easy to grow, however, harvesting and seed cleaning can be difficult.

The fluffy seeds with only just over 1 million seeds per kilogram give a low bushel weight of 193 kg/m^3. Yields range widely from 50 to 400 kg/ha as a result of variable weather conditions at harvest and uneven ripening of seed heads.

Harvesting

Because meadow foxtail seed shatters readily after ripening, seed yields can be greatly reduced. Seed maturity takes about 40 days and is irregular because the seeds mature from the top of the head down. There may be at the most, three-quarters of the head with mature seed at the same time. Harvest readiness occurs quickly as plants mature rapidly.

Maturity dates depend on climatic zone, temperature, moisture, soil type, and fertility regime. At Prince George, B.C., and at Rocky Mountain House, Alta., seed harvest generally occurs by the end of June. When soil moisture is abundant, flowering may be reduced and delayed.

Box 4 A matter of taste ...

Research based on chemical analysis indicates that meadow foxtail should be an excellent forage because of its high nutrient content, especially protein. However, producers in the central interior of British Columbia have observed that, when meadow foxtail is cut as hay and fed free choice with other hays, cattle prefer other grasses. Why? We checked with the cattle and sheep ...

- The earlier this grass is grazed, the more likely it will be accepted by livestock. Sheep have been observed selectively eating the basal leaves and rejecting the seedheads and stems when grazing pure meadow foxtail stands. Cattle are not able to select so diligently as sheep when grazing. Other palatability trials with both cattle and sheep have shown that the animals generally reject this grass once the plant has flowered. Studies suggest that an antiquality factor, which has not been identified, may contribute to the palatability of the grass. Often inclement weather conditions do not allow hay to be cut until later than recommended, especially in the Central Interior of British Columbia. Because meadow foxtail straw has been reported as being highly favored, the antiquality factor may be concentrated in the seedhead. If fields cannot be grazed or cut for hay before flowering occurs, then seed could be direct harvested when ripe and the straw could be baled as forage.

... and the horses

- Horses did not find meadow foxtail as palatable as other grasses including timothy and orchardgrass, in trials conducted in Great Britain.

When meadow foxtail is grazed in mixed stands the meadow foxtail may be rejected. Why?

- Usually when mixed stands are grazed the animals are not put on the fields until all forages in the pasture have good growth. By this time it may be too late for the meadow foxtail! The other forages may be at a more palatable stage of growth. To overcome this problem grow only pure stands of meadow foxtail and graze them as early as possible. It may not seem practical to put livestock on fields that are not firm enough to withstand a reasonable amount of "punching up" of the soil, however regeneration of this grass is good.

Traditional swathing and combining equipment can be used, however seed purity will be only about 20–25%. In Alberta, where most of Canada's meadow foxtail seed production takes place, a special seed harvester (Vertec 2250) has been developed that is more efficient at harvesting meadow foxtail seed. It has a reel with flexible bats that are engaged to hold seed heads against a spinning wire cage. The mature seeds are stripped from the plant while immature seeds are left on the uncut plant. Seeds are then drawn into a duct by pneumatic control and collected in a tank. Meadow foxtail seeds are so light that little air is needed to move the seed. This process produces very clean seed, allows the flexibility at harvesting seed shortly after it rains, and leaves the forage standing in the field. Shattering, weathering, and immature seed losses are lowered considerably and the same field can be harvested for seed more than once as the remaining seed ripens.

Seed handling

Whether swathing followed by combining or straight combining is used, seed must be dried if too wet. The straight combining method is more likely to result in moist seed produced because the plant is still actively growing when harvested. Aeration bins with fans blowing air through the seed can be used to dry the seed.

After combining

The rest of the growing plant can then be cut for hay as the protein content would still be between 7 and 10% if cut at anthesis. Seed set is around June 19th at Prince George. If soil moisture is adequate there is still time for good regrowth of the stand, which can then be used for late summer and fall pasture. Fall grazing does not lower seed production in the following year.

Other uses

With its ability to withstand flooding and grow in wetland areas, it seems natural that meadow foxtail should be a beneficial grass for waterfowl nesting areas. Generally ducks prefer grasses taller than meadow foxtail. However, because waterfowl like a mixture of grasses, meadow foxtail may be useful in a mix for its early growth. The main drawback is that meadow foxtail out competes other grasses that are less tolerant to water. Meadow foxtail spreads easily in waterways and may become a weed. Therefore plan carefully before seeding. In wetland areas where the extensive root system of reed canarygrass is clogging drain tiles or reducing water flow, meadow foxtail can be used as an appropriate alternative.

Wildlife such as deer and elk find meadow foxtail palatable. In alpine areas meadow foxtail is one of the first grasses to grow in the spring giving wildlife some forage soon after the snow melts. It is well suited to moist alpine meadows.

For soil conservation, meadow foxtail may be of some use in waterlogged areas. However, other grasses such as reed canarygrass have better root systems for stabilizing banks.

Meadow foxtail has not performed well in revegetation of landfill sites. The high salinity of many landfill sites slows the growth and development of meadow foxtail.

Recommendations for use of meadow foxtail

Meadow foxtail is not superior to timothy and orchardgrass where these grasses are well adapted but has special value on lands too wet for most grasses.

- Seed only in wetter areas.
- Do not seed large areas to this grass because it needs good and careful management.
- Graze early (calcium supplementation may be necessary).
- Cut early for hay or silage compared to most other grasses.
- When hay cannot be cut early, harvest the seed before cutting the forage.

Acknowledgments

The authors much appreciate the work of the staff at the Prince George Experimental Farm, who over the years have evaluated meadow foxtail in the field and as animal fodder. Some of that work is included in this production guide. Dr. A.R. McElroy of the Agriculture Canada Plant Research Centre supplied us with yield data for meadow foxtail for Ontario. Drs. J.A. Robertson, D.G. Stout, A.L. van Ryswyk, and D.A. Quinton, from the Kamloops Research Station, made useful suggestions for improving our manuscript. Mrs. Ann Robertson, input some of the corrections and suggested changes to the later drafts of this manuscript. Dr. Walter Carlson, a local rancher, provided us with some of his practical experience of haying and feeding livestock meadow foxtail hay. Mr. Bill Smith from the Food Production and Inspection Branch, Agriculture Canada, Kelowna, B.C., provided the herbicide information.

More reading

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CONVERSION FACTORS FOR METRIC SYSTEM

Multiply an imperial number by the conversion factor given to get its metric equivalent.
Divide a metric number by the conversion factor given to get its equivalent in imperial units.

Imperial units	Approximate conversion factor	Results in	
Length			
inch	x 25	millimetre	(mm)
foot	x 30	centimetre	(cm)
yard	x 0.9	metre	(m)
mile	x 1.6	kilometre	(km)
Area			
square inch	x 6.5	square centimetre	(cm^2)
square foot	x 0.09	square metre	(m^2)
square yard	x 0.836	square metre	(m^2)
square mile	x 259	hectare	(ha)
acre	x 0.40	hectare	(ha)
Volume			
cubic inch	x 16	cubic centimetre	(cm^3, mL, cc)
cubic foot	x 28	cubic decimetre	(dm^3)
cubic yard	x 0.8	cubic metre	(m^3)
fluid ounce	x 28	millilitre	(mL)
pint	x 0.57	litre	(L)
quart	x 1.1	litre	(L)
gallon (Imp.)	x 4.5	litre	(L)
gallon (U.S.)	x 3.8	litre	(L)
Weight			
ounce	x 28	gram	(g)
pound	x 0.45	kilogram	(kg)
short ton (2000 lb)	x 0.9	tonne	(t)
Temperature			
degrees Fahrenheit	(°F – 32) x 0.56 or (°F – 32) x 5/9	degrees Celsius	(°C)
Pressure			
pounds per square inch	x 6.9	kilopascal	(kPa)
Power			
horsepower	x 746	watt	(W)
	x 0.75	kilowatt	(kW)
Speed			
feet per second	x 0.30	metres per second	(m/s)
miles per hour	x 1.6	kilometres per hour	(km/h)
Agriculture			
gallons per acre	x 11.23	litres per hectare	(L/ha)
quarts per acre	x 2.8	litres per hectare	(L/ha)
pints per acre	x 1.4	litres per hectare	(L/ha)
fluid ounces per acre	x 70	millilitres per hectare	(mL/ha)
tons per acre	x 2.24	tonnes per hectare	(t/ha)
pounds per acre	x 1.12	kilograms per hectare	(kg/ha)
ounces per acre	x 70	grams per hectare	(g/ha)
plants per acre	x 2.47	plants per hectare	(plants/ha)

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